Fugro, Pembina County and Cavalier County North Dakota Survey Report
Prepared by Professional Mapping and Surveying, LLC
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Job# 17-4291

1. GENERAL INFORMATION
    a. Project Coordinate System
        i. Horizontal: NAD83(2011)
        ii. Vertical: NAVD88
    b. Coordinate Projection
        i. UTM ZONE 14 North
    c. Units: Meters

2. SURVEY TECHNIQUES
    a. Equipment
        i. Trimble GPS
            1. R8 GNSS Model 2, R8 GNSS Model 3
        ii. Topcon
            1. Hiper Lite+ GNSS
    b. Field Methodology
        i. Static GPS/GNSS was utilized and included observations of one to ten second intervals (epochs) with a ten-degree mask. Observation durations ranged from 30 minutes to 8 hours dependent on baseline length.

3. CONTROL NETWORKS
    a. For each county a Primary Network including Static baseline observations introduced, processed and a network adjustment utilizing OPUS Projects resulted in the Primary Control. OPUS Projects provides the ties to the NSRS. This Primary Network includes multiple NGS CORS stations and project specific Primary Control Points including private constant operating stations. Detailed results of the OPUS Projects Network are located below in Item 9, page 8 and Item 10 Page 14.
    b. Upon completion of the Primary Network the LiDAR control and check points included similar static field applications, processing and network adjustments discussed in items 2 and 3 above provided multiple secondary network results. These secondary networks included established Primary Control and checkpoints. The results of these secondary networks are located below in Item 11, pages 31-56 and Item 12 pages 56-65 . Photos of all control and check points were digitally provided to the client.
    c. The LiDAR check points are classified per information provided by the client in *Table 3. Land cover classes*. Specific classifications for this county include NVA (primarily urban); VVA (tall grass); and VVA (wooded). Classifications are listed in below in Item 6, page 2 and Item 8, page 5. Photos of the check points were provided to the client digitally.

4. SUMMARY

    a. LiDAR Ground Control Points and LiDAR Check Points inclusive of this report have an estimated accuracy of the adjusted coordinates of +-0.03 with respect to the NAD1983(2011) and NAVD 1988 Datums.